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14. ABSTRACT
With the help of my graduate student at Columbia University (Asmi Napitu who is from Indonesia) I have arranged a plan for the development and implementation of an EM APEX program within the Banda Sea of the Indonesian maritime continent, a program in collaboration with Ren-Chieh Lien of the Applied Physics Laboratory, University of Washington. Two options are available for deployment of two EM APEX floats in the summer of 2016: 1. with Agus Atmadipoera and Indra Jaya of the University of Bogor aboard the Baruna Jaya 7 in July 2016; 2. with the Ministry of Marine Affairs and Fisheries of Republic of Indonesia (KKP), Bali BPPL lab on their Baruna Jaya 8 cruise in August 2016. Arrangement to ship the EM APEX float to Indonesia in the spring 2016 are being arranged.

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mixing within the Banda; EM APEX floats; upper ocean processes; mixed layer dynamics

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Measuring Turbulence Mixing in Indonesian Seas Using Microstructure EM-APEX Floats

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§ Introduction: The objective of Gordon N00014-15-1-2307 was to engage in the development and implementation of an EM APEX program within the Indonesian Seas with Ren-Chieh Lien of the Applied Physics Laboratory, University of Washington, Seattle. Fieldwork within Indonesian waters involving non-Indonesian researchers, is a challenge: permits, shipping and clearances are difficult to obtain, particularly for high tech instrumentation.

The Indonesian seas or maritime continent is at the nexus of key components of the ocean and climate systems, such as ENSO, Asian monsoon and at intraseasonal scales-the Madden-Julian Oscillations (MJO). The MJO dynamics is at the core of the Year of the Maritime Continent (YMC) program as well as the ONR PISTON program. The EM APEX program we strive to implement may be looked upon as a pilot program that if successful has the potential to lead to larger, more elaborate field programs investigating upper ocean dynamics.

EM APEX float measurements provide details of temperature, salinity, and velocity fluctuations associated with internal tides and inertial waves. They also capture the evolution of surface mixed layer, including its thickness, temperature, salinity, and heat content. EM APEX data can then quantify the effects of wind-generated inertial waves and internal tides on modifying the surface mixed layer depths, SST and identify the shear instability across the surface mixed layer, quantify the turbulence heat flux, and the vertical propagation and dissipation of inertial waves. These are all critical issue in understanding the upper ocean processes that govern air-sea fluxes and the ocean impact on MJO events traversing the MC.

A. Gordon's collaboration of Ren-Chieh Lien and Asmi Napitu in data analysis of the EM APEX data will continue after the April 2016 termination of N00014-15-1-2307,

as part of the pending proposal at ONR: "Low Latitude Indian to Western Pacific, from 40°E to 160°E".

§ Background: Agus Atmadipoera and Indra Jaya of the University of Bogor were approached in January 2014 for the development of an EM APEX program within Indonesian waters. This probably was not the best contact point to move the program forward. University of Bogor lacks influence in the ship scheduling or acquiring field program approval or funding. The Indonesian governmental agencies [BPPT, LIPI, KKP] operate research ships and have related research budgets, are more appropriate primary partners. Agus and Indra were themselves guests to participate on a research cruise, hence the following negotiations between UW and University of Bogor were not being conducted directly with the ship operators. Additionally, e-mail communication with Agus and Indra has been erratic, with long periods of silence, likely due to their inexperience in dealing with approval/clearance issues.

When the University of Bogor arrangements were not moving forward, I (A.Gordon) got involved with the support of N00014-15-1-2307. Working with Asmi Napitu (A PhD graduate student at Columbia University under my supervision; Asmi, an Indonesian, is supported by a Schlumberger Foundation "Faculty for the Future program" fellowship; PhD award likely in spring 2017). We arranged deployment in the summer 2016 (windy period when the processes measured by the EM APEX floats were most active) by Ministry of Marine Affairs and Fisheries of Republic of Indonesia (KKP), while balancing the interest and involvement of University of Bogor researchers. The Makassar mooring time series that we run from Lamont is in collaboration with KKP, since 2007. Asmi is affiliated with KKP and has significant leverage at KKP; KKP has many cruises in Banda Sea in 2016. Asmi's PhD dissertation deals with the MJO and on the upper ocean processes within the Banda Sea, forms a natural synergy with the EM-APEX program.

§ The current status of EM APEX: The EM APEX float deployment would be handled by BPPL, the KPP Bali lab, (see wiring diagram at the end of this report) using the research vessel Baruna Jaya 8 (BJ8) in the Banda Sea in August 2016. BPPL has a fish stock assessment program covering the Banda Sea and surroundings seas and can devote the time to deploy and recover the EM APEX floats in the northern Banda Sea providing a 2 to 3 week time series. We have established good communication with Dr. Ali Suman for a collaborative research between his BPPL, the University of Washington and LDEO of Columbia University.

After many months of silence, Agus and Indra returned. They, as guests on a July 2016 with BJ 7 (a smaller and slower ship than the BJ8) also a BPPL/KKP fish stock assessment cruise to the Arafura Sea (east of the Banda Sea), invited

deployment/recover of the EM APEX floats in the northern Banda Sea (en route to the Arafura Sea). There were complications with shipping of the floats from the US as UW didn't have an MOU with KKP, as they do with the University of Bogor. Our plan is to use the UW/ University of Bogor MOU to ship the floats for the BPPL/KKP sponsored cruise, either the July or August 2016 cruises.

I'll meet with Agus to talk about shipping documents when Asmi and I are in Jakarta (May 9-11, 2016; travel covered by the budget of the pending proposal at ONR). If July 2016 cruise does not work out, we will return to the arrangement with Asmi's colleagues at the BPPL/KKP and join their BJ8 cruise in August 2016. Arrangement to ship the EM APEX float to Indonesia in the spring 2016 must be arranged soon. By the end of May we hope to settle on one of the 2 deployment cruise options; Indra and Agus can be appointed as guest scientists for the BJ8 cruise, so they can still be part of the activity, and help in the shipment from UW of the EM APEX floats.

There are still challenges to bring the EM APEX to the implementation phase, mainly coordinating shipping and clearance between US and BPPL/KKP and the University of Bogor. We recognize the need to develop the EM APEX program in a friendly, collaborative [non-competitive] mode, following the protocol of the various Indonesian partners.

KKP recently re-wiring diagram: